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14. ABSTRACT

China's response to the U.S.'s easy defeat of Iraq in the 1991 Gulf War was to close the military technology gap that existed between China and U.S. To accomplish this goal, China achieved a worldwide near-monopoly of Rare Earth Elements (REE) mining and used this near-monopoly to coerce companies to move the manufacturing that required REE to China, which allowed China to procure the intellectual property of the manufactured item. Since REE are used in almost all high-tech equipment, China has closed the technology gap and has nearly achieved Second Offset parity. REE will play an even greater role in future technological advancements. To combat China's and other nations' near military parity, the U.S. has announced the Third Offset Strategy to create technological equipment that will give the U.S. a multi-decade military advantage. This thesis shows, that for the United States to successfully achieve the game-changing goals of the new Third Offset Strategy, it must create a comprehensive strategy that incorporates the Diplomatic, Information, Military, and Economic aspects of national power (DIME) to mitigate the effects China's ability to acquire the intellectual property behind the cutting-edge technologies required by the Third Offset Strategy.

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The Rare Earth Collision: A Hit and Run on the Third Offset Strategy

by

Daniel P. Ellinger

COL, U.S. Army

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

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Stephen C. Rogers, Colonel, USA
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ABSTRACT

China's response to the U.S.'s easy defeat of Iraq in the 1991 Gulf War was to close the military technology gap that existed between China and U.S. To accomplish this goal, China achieved a worldwide near-monopoly of Rare Earth Elements (REE) mining and used this near-monopoly to coerce companies to move the manufacturing that required REE to China, which allowed China to procure the intellectual property of the manufactured item. Since REE are used in almost all high-tech equipment, China has closed the technology gap and has nearly achieved Second Offset parity. REE will play an even greater role in future technological advancements. To combat China's and other nations' near military parity, the U.S. has announced the Third Offset Strategy to create technological equipment that will give the U.S. a multi-decade military advantage. This thesis shows, that for the United States to successfully achieve the *game-changing* goals of the new Third Offset Strategy, it must create a comprehensive strategy that incorporates the Diplomatic, Information, Military, and Economic aspects of national power (DIME) to mitigate the effects China's ability to acquire the intellectual property behind the cutting-edge technologies required by the Third Offset Strategy.

DEDICATION

I dedicate this thesis to my wife and children who supported me through the many long hours of the Joint Advanced Warfighting School (JAWS) curriculum. It is their understanding, support, sacrifice, and love that has made this possible.

Thank You.

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Introduction:

In 1991, the United States shocked the world when they handily defeated the world's fourth largest Army in just a few days. The Gulf War announced to the world that the invention and innovation of the U.S.'s Second Offset Strategy, first envisioned during the Cold War, resulted in the U.S. being the world's only super power with overwhelming military technological superiority.[1] "Don't fight the United States in a conventional war" became the universally accepted mantra, except in China. China's response to the Gulf War was to demand that the Chinese People Liberation Army (PLA) could fight and win wars "under high technology conditions."[2] Since 1991, China's National Military Strategies have focused on the acquisition of Second Offset technologies through limited internal R&D, wholesale technological purchases, and widespread intellectual theft.[3] China's intellectual theft has two primarily methods—covert means outside of China and coercive means within the high-tech manufacturing in China. For the past 20 years, China has convinced or coerced companies to move their high-tech product manufacturing to China to take advantage of cheap labor, lack of environmental regulations, and readily available access to Rare Earth Elements (REE) since, at any time, China can and has stopped exporting REE.

[1] Chapter two of this thesis will cover the United States' Offset Strategies in more detail. Also see generally Robert Farley's The National Interest Article, "What Scares China's Military: The 1991 Gulf War" and David Blair's UK Telegraph article "The Gulf War marked the pinnacle of American military supremacy."
[2] Laurie Burkitt, Andrew Scobell, and Larry M. Wortzel, *The Lessons of History: The Chinese People's Liberation Army at 75* (Carlisle, PA: Strategic Studies Institute, 2003), 214.
[3] See generally Samuel P. Huntington's Foreign Affairs Article "The Clash of Civilization" and Kevin Pollpeter's Rand Study "U.S.-China Security Management."

"A Chinese company bought the company, called Magnequench, … The jobs went to China, but so did the technology. And now the United States military has to buy the magnets we need for the smart bombs we invented from China." Senator Hillary Rodham Clinton, April 29, 2008[4]

Magnequench was the U.S. company that in 1982 invented the neodymium magnet, the world's most powerful magnet, that is primarily composed of a REE. The advent of this magnet allowed for electronic miniaturization and, along with other REE advancements, has become a foundation of the modern technological age that defined the last 35 years. Currently, REE are indispensable in almost all high-tech components and are *a* if not *the* critical material in technological research and development (R&D). The Bosnian War, the start of the Third Taiwan Strait Crisis, the nerve gas attacks in Tokyo, and the massacres in Rwanda drew the world's attention in 1995. Yet, one of the most critical and enduring events that year was a little publicized business transaction, which was also the first act in China's strategy to take over the high-tech manufacturing sector with the acquisition of Magnequench

Until the Magnequench acquisition, China's involvement in the REE industry was limited to mining their REE reserves and selling them to high-tech manufacturing companies around the world. After the Clinton administration approved the sale of Magnequench to a Chinese state-owned company, China proceeded to corner the REE market and use their REE near-monopoly to coerce high-tech companies that required REE to move their manufacturing to China, thus giving China both the REE downstream industries and access to the high-tech intellectual property. Without REE, there is no high-tech product manufacturing, commercial or military.

[4] Senator Hillary Clinton, "Political Address" (Speech, Princeton, Valparaiso, Indiana, April 12, 2008). ABCnews, http://abcnews.go.com/Politics/Vote2008/story?id=4757257&page=1 (accessed on October 2, 2016)

Today, the United States acknowledges that its competitive advantage of the Second Offset Strategy is coming to an end. Other nations, like China, are acquiring and rapidly implementing the Second Offset's technologies. If the United States is to maintain its unipolar military status, it needs a new strategy. So, on November 15, 2014, Secretary of Defense Hagel announced "a new Defense Innovation Initiative – an initiative that we expect to develop into a game-changing Third 'Offset' Strategy" like the definitive advantage created by the Second Offset Strategy in 1991.[5] Yet the reasons that other nations, particularly China, have closed the U.S.'s competitive advantage of the Second Offset Strategy remain present. China's R&D continues to advance internally and via intellectual theft.

For the United States to successfully achieve the *game-changing* goals of the new Third Offset Strategy, it must create a comprehensive strategy that incorporates the Diplomatic, Information, Military, and Economic aspects of national power (DIME). Such a strategy would mitigate the effects of China's REE near-monopoly has on China's ability to acquire the intellectual property behind cutting-edge technologies required by the Third Offset Strategy. A broader discussion of China's and other nations' R&D status and progress is best left to specialists and the classified realm, thus it is beyond the scope of this thesis.

[5] Chuck Hagel, "Reagan National Defense Forum Keynote," (Speech, Simi Valley, CA, November 15, 2014) Department of Defense, http://www.defense.gov/News/Speeches/Speech-View/Article/606635 (accessed September 29, 2016). Chapter three covers the Third Offset Strategy in more detail.

Chapter 1: Chinese Rare Earth Element Dominance:

"中東有石油，中國有稀土" (The Middle East has its oil, China has rare earth) Deng Xiaoping in 1992.[1]

Section 1: What are Rare Earth Elements?

"Without that small amount of yeast there's no pizza; without rare metals there's no high-tech world." David S. Abraham, 2015.[2]

Ironically named, the 17 elements that make up Rare Earth Elements (REE) are not rare but some of the most common elements found on earth. Several of them are more common than Nitrogen, and the rarest of the 17 is as common as Iodine.[3] Yet, REE do not exist in pure form like most elements, e.g. gold and silver, but are almost always found with a radioactive element making REE extremely difficult to extract, separate, and process.[4] Therefore, only the extremely rare REE deposits are commercially viable for mining. Compounding the difficulty in mining is the enormous amount of toxic chemicals and radioactive material, Thorium, in the mining waste that currently has no economic use and is strictly regulated by the U.S. Environmental Protection Agency (EPA), other countries' regulatory agencies, and international organizations like the United Nations (UN) and the International Atomic Energy Agency (IAEA).

Thorium is a natural, low level radioactive element that is in almost everything. It is so common that the average person consumes three micrograms of Thorium per day.[5]

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[1] JianJun Tu, "An Economic Assessment of China's Rare Earth Policy," *The Jamestown Foundation's China Brief* Vol X, Issue 22, November 5, 2010, 3
[2] David S. Abraham, *The Elements of Power in the Rare-Metal Age* (New Haven: Yale University Press, 2015), 3
[3] U.S. Department of the Interior, United States Geological Survey, *Rare Earth Elements-Critical Resources for High Technology*, by Gordon B. Hazel, James B. Hedrick, and Greta J. Orris, open-file report, U.S. Geological Survey, pt. 087-02 (Washington, DC, 2002), 7.
[4] *Ibid*, 9.
[5] John Emsley, *Nature's Building Blocks: An A-z Guide to the Elements* (Oxford: Oxford University Press, 2011), 544-545.

In 1980, the IAEA changed the classification of naturally found Thorium to Source Materiel, the IAEA term for raw materiel for nuclear weapons, which increased the security and environmental handling requirements and dramatically increased the mining cost of REE in countries that abide by the IAEA Statute treaty.[6]

The U.S. Geological Survey estimates that the world has 130 million (M) tons of mining grade REE, with the BRICS nations--China (42% of the world's supply), Brazil (17%), Russia (16%), and India (2%)--comprising 78% of the world's supply.[7] Outside of the BRICS nations, only Australia (3%) has more than 2% of global supply, with the U.S. at 1.5%.[8] The amount of REE that a country can mine does not directly equate to what a country produces. In 2015 China produced 85% of the world's REE production and 100% for some specific REE.[9] Australia produced 8% while Russia and Thailand each produced 2% of the world's output.[10] The U.S. had produced 3% of the world's supply, but the last U.S. REE mine closed at the end of 2015. Japan is not a producer of REE.

Rare Earth Elements (REE) are a critical, yet not commonly known, part of 21st century life. REE are key components in smartphones, laptops, cameras, catalytic converters, hybrid cars, fluorescent lights, and the modern renewable energy industry, to name only a few. The amount of REE used varies per item. A smart phone uses only a few grams, yet the billion smart phones manufactured each year multiply the smart phone

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[6] James Kennedy, "Address to International Atomic Energy Agency on Thorium and Rare Earth Elements," (Speech, Vienna, Austria, June 27, 2014)
[7] U.S. Department of the Interior, United States Geological Survey, *Mineral Commodity Summaries 2016*, by Joseph Gambogi, open-file report, U.S. Geological Survey (Reston, Virginia, 2016), 135
[8] *Ibid.*
[9] Lee Simmons, "Rare-Earth Market," *ForeignPolicy*, July 12, 2016, https://foreignpolicy.com/2016/07/12/decoder-rare-earth-market-tech-defense-clean-energy-china-trade/ (accessed August 30, 2016).
[10] U.S. Department of the Interior, *Mineral Commodity Summaries 2016*, 135

demand for REE. Each megawatt of capacity for a wind turbine requires about 450 lbs of REE, which means the U.S.'s smallest wind farm by power output requires over 13,000 lbs of REE.[11] With the increased demand for personal and commercial electronics, as well as a 700% projected growth in the wind turbine industry in the next 25 years and the increase of other renewable energy sources, the demand for REE will only increase.[12] Not surprisingly, China, Japan, and the United States are currently the world's largest consumers of REE.

REE are also a critical part of modern military systems where they are used in nearly every modern guidance system, communication system, laser, avionics system, and night vision device used in aircraft, vessels, munitions, rockets, and personnel issue equipment. The F-35 fighter aircraft program alone will require over ½ million pounds of REE to produce the 550 F-35s scheduled from 2016 to 2021. Additionally, each Aegis destroyer requires 5,200 lbs of REE, and a single Virginia class Submarine requires 9,200 lbs of REE.[13]

As important as REE are for current technological equipment, their role in future technology is even greater. The unique properties of REE allow a tiny amount of REE to achieve the same, or better, results than large quantities of other materials. This makes

[11] Renee Cho, "Rare Earth Metals: Will We Have Enough?," Columbia University - Earth Institute, http://blogs.ei.columbia.edu/2012/09/19/rare-earth-metals-will-we-have-enough/ (accessed September 9, 2016). Rod Adams, "Is Offshore Wind Finally Ready To Serve U.S. Power Needs?," Forbes, August 16, 2016, http://www.forbes.com/sites/rodadams/2016/08/17/is-offshore-wind-finally-ready-to-serve-us-power-needs/#3dd8a79b5468 (accessed on October,11 2016). Rhode Island's Block Island Wind Farm is the U.S.'s smallest wind farm by power output.

[12] Cho, "Rare Earth Metals"

[13] Richard Whittle, "Pentagon Fails to Act on Crucial Rare Earth Minerals," *Breaking Defense*, March 01, 2016, http://breakingdefense.com/2016/03/pentagon-fails-to-act-on-crucial-rare-earth-minerals/ (accessed on August 28, 2016). While there are estimates of the REE requirements for individual military systems, there are no reliable estimates for the total REE consumption for military equipment for the US, China, Russia, or any other nation.

REE indispensable to miniaturization—nanotechnology, mini-drones, and nanobots—and space travel where each pound sent into space costs more than $25,000.[14] REE are also indispensable in green energy technologies and medical imaging devices. Universities and businesses are using REE to develop Li-Fi (Light Fidelity) to replace the radio wave based Wi-Fi at speeds 10 to 100 times faster.[15] And several universities are even experimenting with REE to make shape-shifting materials.[16]

Section 2: China's Near-Monopoly

"If the U.S. Monopoly capitalist groups persist in pushing their policies of aggression and war, the day is bound to come when they will be hanged by the people of the whole world. The same fate awaits the accomplices of the United States." Mao Zedong 1958.[17]

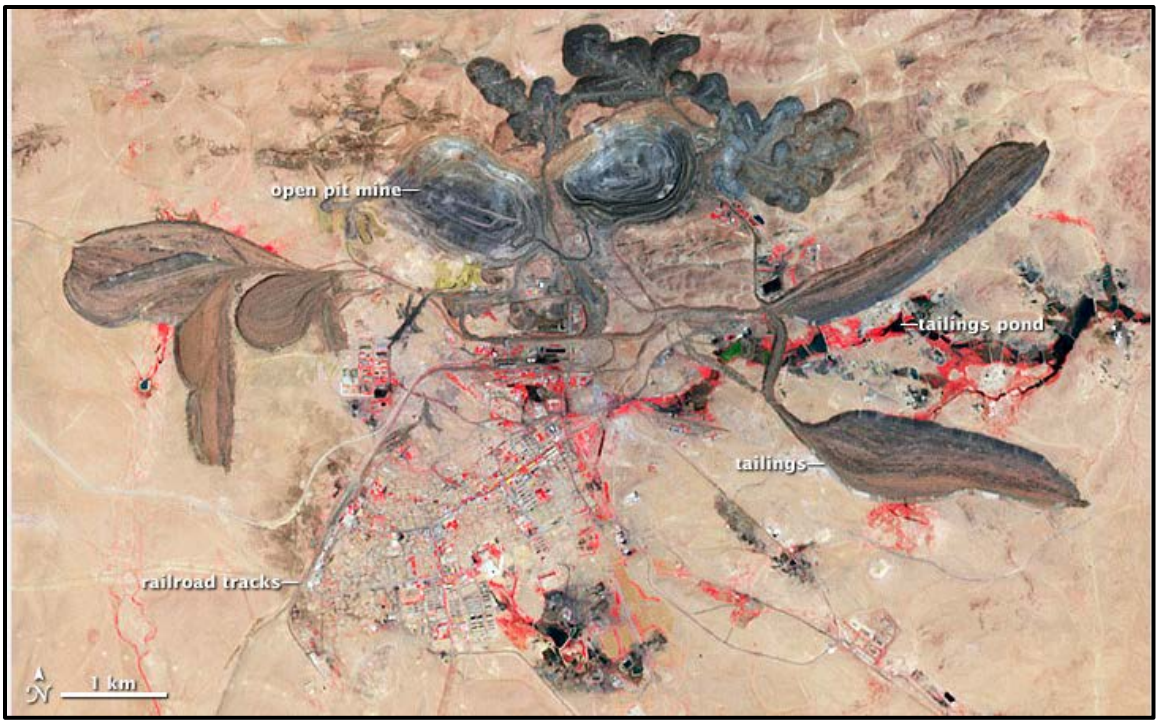
There are many definitions of what precisely a near-monopoly is, but all include a requirement for a single entity to control enough of, but not all of, a product that it gives this entity the capability of controlling the entire market. Control is not a requirement for a near-monopoly just the capability of control, if the entity desires. In 1980 the U.S. was the world's leading provider of REE while China was not a producer.[18] By 1995, China produced more than half of the world's REE; by 2000, 82% of the world's REE supply; and by 2005 China produced 97% of the world's REE supply while the U.S. ceased

[14] Sarah Kramer and Dave Mosher, "Here's How Much Money It Actually Costs to Launch Stuff into Space," *Business Insider*, Jul. 20, 2016, 1, http://www.businessinsider.com/spacex-rocket-cargo-price-by-weight-2016-6 (accessed December 30, 2016).
[15] Shubham Chatterjee, Shalabh Agarwal, and Asoke Nath, "Scope and Challenges in Light Fidelity (LiFi) Technology in Wireless Data Communication," *International Journal of Innovative Research in Advanced Engineering* Vol 2, no. 6 (June 2015): 1 http://www.academia.edu/14033937/IJIRAE_Scope_and_Challenges_in_Light_Fidelity_LiFi_Technology_in_Wireless_Data_Communication (accessed December 30, 2016).
[16] Yukiko Ogawa et al., "A Lightweight Shape-Memory Magnesium Alloy," Tohoku University, http://www.tohoku.ac.jp/en/press/new_lightweight_shape_shifting_alloy.html (accessed December 30, 2016).
[17] Mao Zedong, "Speech at the Supreme State Conference," September 8, 1958, *Quotations from Chairman Mao Tsetung* (Peking: Foreign Languages Press, 1967), 79.
[18] Hobart King, "REE – Rare Earth Elements and Their Uses," *Geology.com*, http://geology.com/articles/rare-earth-elements/ (accessed October 11, 2016)

producing REE.[19] From 2005 to 2015, China maintained at least an 85% market share. With the closure of the last U.S. REE mine in 2015, China's 2016 market share will only increase.[20] While all scholars agree that China has had a REE near-monopoly for over a decade, there is disagreement about whether China intentionally created this near-monopoly.

In 15 years, China progressed from producing almost no REE to producing a majority of the world's supply. Dr. Kevin Jianjun Tu stated, "China's dominance in the RE (rare earth) supply chain is directly related to Beijing's consistent and long term planning."[21] He cites the principal reasons that gave China its REE near-monopoly as its low labor cost, heavy governmental investment, and the 1981 "Let Water Flow Rapidly" policy of little to no regulations, environmental protections, or safety considerations.[22]

[19] U.S. Department of the Interior, United States Geological Survey, *China's Rare-Earth Industry,* by Pui-Kwan Tse, Open-file report, U.S. Geological Survey (Reston, Virginia, 2011): 2. J.T. Brown , et al, "World Mineral Production: 2005-2009," British Geological Survey, Natural Environment Research Council (Nottingham, UK, 2011), pp 83.
[20] King, "REE – Rare Earth Elements and their Uses"
[21] Tu, "An Economic Assessment of China's Rare Earth Policy." Dr. Kevin Jianjun Tu is the Senior associate in the Carnegie Endowment for International Peace Research, fellow at the Canadian Industrial Energy End-use Data and Analysis Centre, and former council member of the Government of China's International Cooperation on environment and Development council
[22] Ibid.



Upper: Baotou REE mine and city, population 2 million, site photo. Middle Left: Road through Baotou site. Middle right, lower left, and lower right: Baotou REE mine byproduct lake and trailings.[23]

[23] "Rare-Earth Mining in China Comes at a Heavy Cost for Local Villages," *Guardian*, 7 August 2012, https://www.theguardian.com/environment/2012/aug/07/china-rare-earth-village-pollution (accessed November 30, 2016); Tim Maughan, "The Dystopian Lake Filled by the World's Tech Lust," *BBC*, 2 April 2015, http://www.bbc.com/future/story/20150402-the-worst-place-on-earth (accessed November 29, 2016), and "Earth Observatory: Rare Earth in Bayan Obo," *NASA*, April 21, 2012, http://earthobservatory.nasa.gov/IOTD/view.php?id=77723&src=eoa-iotd (accessed December 30, 2016).

Dr. Casey Lucius concludes that China's Critical Resources Strategy was planned, since mining exploration and development appeared in every Government Five Year Plan since 1953.[24] These and other scholars state that China's policies intentionally kept the price of REE low—prices dropped by 60% from 1992 to 2006—and readily available in order to drive all other mining and processing companies out of business.[25] Dr. Jost Wubbeke states that the purpose of this intentional monopoly is to create a downstream sector—matching high-tech businesses to the REEs in China instead of shipping the REE to other high-tech businesses around the globe.[26]

Other Scholars state that China's near-monopoly was an unintentional and unwanted situation. Their perspective is that China's Government didn't artificially keep the REE prices low. The prices were low for the same reason the manufacturing costs are low in China—the low cost of labor and the lack of restrictive environmental laws. Dr. Eugene Gholz states that the world gave China the REE near-monopoly that they did not want when the U.S. environmental laws caused the closure of all U.S. REE mines.[27] Other scholars highlight the fact that China, as an investor in REE mining and exploration projects throughout the world, is actively working to increase the global supply, so they can use more of their internal supply on domestic applications. Yet, other

[24] Casey J. Lucius, "China's Critical Resources Strategy," in Donovan C. Chau and Thomas M. Kane (Eds.), *China and International Security: History, Strategy, and 21st-Century Policy* (Santa Barbara: Praeger Security International, 2014), Vol. 3, p. 170. Dr. Casey Lucius is a former Professor at the Naval Postgraduate School.
[25] Tu, 3
[26] Jost Wubbeke, "China's Rare Earth Industry and End-Use: Supply Security and Innovation," in The Political Economy of Rare Earth Elements: Rising Powers and Technological Change (New York: Palgrave Macmillan, 2015), 20-42. Dr. Jost Wubbeke is the head of Programme Economy & Technology of the Mercator Institute for China Studies.
[27] Eugene Gholz, "*Rare Earth elements and National Security*," (New York: Council on Foreign Relations, 2014), 10. Dr. Eugene Gholz is a professor at the LBJ School of Public Affairs at the University of Texas, an Adjunct Scholar for the CATO Institute, and former Pentagon Senior Advisor for Manufacturing and Industrial Base policy

scholars state that this foreign investment is an additional attempt to control the market by forcing new mining companies to ship their raw REE to China for processing.

If, like many experts believe, China intentionally created their REE near monopoly, it shows that the Chinese Government has a long term Grand Strategy that uses and threatens to use its control of the REE market. If so, the next step is a discussion of how to minimize and ultimately eliminate the strategic impact of this situation in the U.S. Third Offset Strategy. While Dr. Gholz and other experts express a powerful argument that China did not intentionally create their REE near monopoly. Intention, however, is not relevant to discerning near monopoly status. The reality that China could exercise control leads to the control question: Has China incorporated their REE near monopoly into their Grand Strategy?[28]

Section 3: REE in China's Diplomatic and Economic Instruments of National Power

> "Our aim is to gain control of the two great treasure houses on which the West depends—the energy treasure house of the Persian Gulf and the mineral treasure house of central and southern Africa." Leonid I. Brezhnev confided to Somali President Siad Barre who, years later, separately related this information to both President Nixon and Winston Churchill II.[29]

On 7 September 2010, a Chinese trawler collided with a Japanese Coast Guard patrol boat in an area of the East China Sea claimed by both Japan and China.[30] The detention of the Chinese skipper by the Japanese patrol boat captain caused a brief diplomatic incident that ended on 24 September when the Japanese government released

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[28] See generally Ye Zicheng, *Inside China's Grand Strategy: The Perspective from the People's Republic* (Lexington: The University Press of Kentucky, 2011).
[29] Ezrah Aharone, *Pawned Sovereignty: Sharpened Black Perspectives on Americanization, Africa, War, and Reparations*, (Bloomington: Authorhouse, 2003), 179; Richard M. Nixon, *The Real War* (New York: Warner Books, 1980) 23; and Winston S. Churchill II, *Defending the West* (Westport, CT: Arlington House, 1981), 145-46.
[30] Masami Ito and Mizuho Aoki, "Senkaku Collisions Video Leak Riles China," *The Japan Times News*, November 6, 2010, http://www.japantimes.co.jp/news/2010/11/06/news/senkaku-collisions-video-leak-riles-china/ (accessed October 2, 2016).

the Chinese skipper.[31] This event, like dozens of other similar events, would have gone down in history as a typical territorial dispute if it wasn't for a September 22, 2010 article from *Industrial Minerals*, a small online mining magazine, titled **"**China bans Japan RE exports."[32] This article picked up by dozens of news outlets around the world still resonates today with businesses, government economy policies, and national security interests across the globe. The timing of ban is not conclusive but certainly coincides with and suggests that China is testing its control of its REEs near monopoly.

Dr. Kyoto Hatakeyama, Dr. Maximilian Rech, Congressman Don Manzullo, and many other scholars, politicians, and businessmen agree that China used the embargo as an element of national power to pressure Japan against making its territorial waters claims and to release the Chinese trawler skipper.[33] When Japan released the skipper, REE were again available for import into Japan. The U.S. Congress even held special hearings on the Chinese political use of REE.[34] Yet not all agree, and even at the time of the incident there were several articles in the Wall Street Journal and other publications disputing the meaning of the Chinese REE embargo.[35] Dr. Gholz stated that the Chinese

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[31] Yuko Lnoue, "China Lifts Rare Earth Export Ban to Japan: Trader," Reuters World News, September 29, 2010, http://www.reuters.com/article/us-japan-china-export-idUSTRE68S0BT20100929 (accessed October 2, 2016).

[32] Simon Moores, **"**Ban on Rare Earths Exports in Reaction to Vessel Capture, Japan Traders Confirm," *Industrial Minerals Magazine*, September 22, 2010, http://www.indmin.com/Article/2675767/Energy-LatestNews/China-bans-Japan-RE-exports.html (accessed on October 10, 2016)

[33] Dr. Kyoko Hatakeyama is at Kansai Gaidai University in Japan and a former analysis for the Japanese Ministry of Foreign Affairs. Dr. Maximilian Rech is the Programme Director and Professor in International affairs at France's prestige ESSCA School of Management. Congressman Don Manzullo, Chairman of Congress Foreign Affairs Subcommittee on Asia and the Pacific.

[34] U.S. House Committee on Foreign Affairs Subcommittee on Asia and the Pacific, *China's Monopoly On Rare Earths: Implications for U.S. Foreign And Security Policy*, 112th Cong., 1st sess., 2011, serial 112-63, 1.

[35] James Areddy, David Fickling, and Norihiko Shirouzu, China Denies Halting Rare-Earth Exports to Japan, *Wall Street Journal*, September 23, 2010, http://www.wsj.com/articles/SB10001424052748704062804575509640345070222 (accessed October 12, 2016)

REE embargo, which the Chinese have always denied, was "The Crisis…That Wasn't" since Japan's stockages were unaffected, and China had been delaying and reducing exports to many nations before this incident.[36] Dr. Gholz state that the impression the China embargo actually hurt its REE near-monopoly since it jump-started REE mining projects all over the world and led to companies creating more efficient manufacturing methods that reduced the need for REE.[37]

In March of 2012 the U.S., European Union (EU), Japan, and 18 other nations filed a World Trade Organization (WTO) complaint on China's REE export restrictions.[38] China had reduced REE exports by 40% from 2009 to 2010 while not limiting internal consumption.[39] In May 2015, the WTO ruled that "China's export quotas were designed to achieve industrial policy" and "secure preferential use of those materials by Chinese manufacturers" was a violation of the WTO rules.[40] While the WTO used the term *Chinese manufacturers*, they actually mean manufacturing done in China. China was limiting the export of REE to manufacturers outside of China, but allowed foreign manufacturers based in China to all the REE they needed.

Since China's REE production went from none in 1980 to a majority by 2000 and a near-monopoly by 2005; its consumption of REE increased from almost none in 1980 to 21% of world production by 2000 and 71% by 2010, a logical relationship of increased supply results in increased consumption is implied.[41] However, the actual relationship is

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[36] Gholz, 1
[37] *Ibib, 5*
[38] World Trade Organization, *DS431: China — Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum,* prepared by World Trade Organization, Dispute Settlement (Geneva, Switzerland, 2015), 1.
[39] Congressional Research Service. *"Rare Earth Elements: The Global Supply Chain."* December 2014 by Marc Humphries. Open-file report, CRS Report for Congress. Washington D.C. 2013, 13, 17
[40] World Trade Organization, 1
[41] Jost Wubbeke, 20-42

less benign since consumption is all in the manufacturing industry, which is mostly non-Chinese companies that have moved their manufacturing to China. What the previous WTO case was really about was China's reduction of REE exports and its threat of an REE embargo to create a high-tech, REE downstream industry in China. This technique of forcing the movement of manufacturing is also known as *supply chain coercion*.[42]

In 1959, scientists from the Mobil Oil Company discovered that using REE in a petroleum catalyst allowed greater fuel extraction from the same amount of oil.[43] Since then, as oil increased in price and demand, the need for these REE catalysts has increased and the W.R. Grace company became the world's largest supply of this catalyst. In 2007, China stopped shipping REE to W.R. Grace until W.R. Grace moved its operations to China.[44] W.R. Grace is, once again, the world's largest supplier of REE catalysts, selling over $1.2 billion worth in 2014.[45] While the number of companies directly cut off from REE are low, the possibility of losing the critical aspect of a component has influenced many component manufacturers to move to China.

In addition to using the REE as leverage to create a high-tech, downstream sector, China also employed the old-fashioned method of acquiring intellectual property—by buying it. A General Motors subsidiary, Magnequench (U.S.) together with Sumitomo Special Metals (Japan) invented a rare earth magnet, also known as a neodymium

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[42] Ibib.
[43] "*Consider Improving Refining and Petrochemical Integration as a Revenue-Generating Option,*" Hydrocarbon Processing 80, no.11 (November 2001), Academic Search Premier, EBSCOhost (accessed December 31, 2016).
[44] Nabeel Mancheri, Lalitha Sundaresan, and S. Chandrashekar, *Dominating the World: China and the Rare Earth Industry* (Bangalore: National Institute of Advanced Studies, 2013), http://investorintel.com/wp-content/uploads/2014/01/China-rare-earth-strategyin-wHighlights-.pdf (accessed November 29, 2016)
[45] U.S. Securities and Exchange Commission, *W. R. Grace and CO. Form 10-K*, Form 10-K (Washington, DC, 2015), F71. https://www.sec.gov/Archives/edgar/data/1045309/000104530915000030/gra-201410xk.htm (accessed January 1, 2017)

magnet, still considered the strongest permanent magnet ever created. These two companies, along with European manufacturers, produced 90% of the world's supply in the mid-1990s. In 1995, the U.S. Government approved the sale of Magnequench—the DoD-contracted rare earth magnet manufacturer for the F-22 fighter jet, the Patriot Missile system, and Joint Direct Attack Munition (JDAM)—to a Chinese company managed by the daughters of then Chinese leader Deng Xiaoping after the company agreed to keep the company in Anderson, Indiana for five years after the sale was completed.[46] The day after the five year agreement expired, the entire company, to include government contracts, manufacturing blueprints, hardware, software, plans, and mineral stockpiles—everything except the employees, who were fired—moved to China. By 2010, China produced 75% of the world's supply of neodymium magnets, Japan 22%, and the United States none.[47]

Section 4: The Future of China's REE Near-Monopoly.

"Without casting a big net how can a big fish be caught"? Uncredited Chinese proverb.

Fears of a Chinese REE embargo and the reduction of REE exports from China spurred the world to innovate to end China's REE near-monopoly. In the United States, the Mountain Pass mine in California, which previously provided the majority of the world's REE, raised over $500M in a public offering to reopen the mine in 2014.[48] In 2012, Lynas Corps began light REE mining in Australia and Malaysia.[49]

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[46] Cindy Hurst, "China's Rare Earth Elements Industry: What Can the Wet Learn*?," Institute for the analysis of Global Security*, March 2010: 12-13
[47] Congressional Research Service. *"Rare Earth Elements: The Global Supply Chain,"* 2
[48] Keith Bradsher, "Challenging China in Rare Earth Mining," *New York Times*, APRIL 21, 2010, http://www.nytimes.com/2010/04/22/business/energy-environment/22rare.html?pagewanted=1&_r=0 (accessed October 16, 2016). Congressional Research Service. "*Rare Earth Elements: The Global Supply Chain,"* 12-13
[49] CRS, "Rare Earth Elements," 13

Companies and countries all over the world are on the hunt for raw REE. In 2013, North Korea announced they discovered the world's largest REE deposit of 216.2 million tons, more than the rest of the world combined.[50] In 2016, India announced they discovered 8 million tons of REE.[51] Russia has invested $1 billion into its REE production to end its importation of REE.[52] Afghanistan, Australia, Canada, Congo, Greenland, Uzbekistan, and even deep ocean REE deposit mining have all been announced. REE recycling projects are starting. Companies have focused on REE conservation to reduce the amount they use. The increased diversity of countries mining domestic REE and using those materials for manufacture suggest a reduction of dependence on Chinese REE.

Yet, in a globalized world economics rule. While there are disagreements on intent, everyone agrees that China has kept enough REE flowing at a price that is 75% cheaper than the average and projected cost for production outside of China.[53] Even the fear of embargo and reduced REE export has not overcome supply and demand. China's REE prices drove U.S.'s Mountain Pass to bankruptcy in 2015.[54] Current REE prices have made most of the recent REE finds uneconomical to mine, and after 3 years of no action taken by North Korea's government and no outside validation, its REE discovery

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[50] Frik Els, "Largest Known Rare Earth Deposit Discovered in North Korea," *Mining.com*, December 5, 2013, 1, http://www.mining.com/largest-known-rare-earth-deposit-discovered-in-north-korea-86139/ (accessed October 10, 2016).
[51] "Rare Earth Minerals Found in Western Raj," *Times of India*, April 28, 2016, http://timesofindia.indiatimes.com/city/jaipur/Rare-earth-minerals-found-in-western-Raj/articleshow/52017142.cms (accessed October 16, 2016).
[52] Gleb Stolyarov, "Russia to Invest $1 Billion in Rare Earths to Cut Dependence on China," *Reuters*, September 10, 2013, http://www.reuters.com/article/us-russia-rareearth-china-idUSBRE9890EI20130910 (accessed October 16, 2016).
[53] Tu, 3
[54] Canada Minister of Natural Resources, Canada Natural Resources, *The State of Global Rare Earths Industry: A review of market, production, processing and associated environmental issues*, by Sevan Bedrossian, Giovanna Gonzales-Calienes, Christopher Baxter, Canadian Rare Earth Element R&D Initiative (Winnipeg, CA, May 25, 2016), 20.

is now highly questionable.[55] As of 2016, the only operational REE mines outside of China that are exporting significant quantities are the Lynas mines in Australia.

Lynas's mining story started in 2009, before the Japanese/Chinese East China Sea incident and alleged REE embargo of 2010. In February 2009, Lynas suspended REE development due to a funding shortage.[56] In May 2009, a Chinese company offered $252M for 52% of the company.[57] The Australian government got involved, the deal disappeared, and Lynas went on to be the world's biggest REE producer outside of China. The cost of mining and the low price that China sells REE on the global market, however, forced Lynas into bankruptcy until a Japanese State-owned company refinanced the Lynas debt in November 2016.[58] Another Australian mining company, Arafura Corporation, in the same financial situation as Lynas in 2009, received a bid from the same Chinese company that previously bid for Lynas, for 25% of the company.[59] This time the Australian Government did not influence the deal, the Chinese company bought 25%, and the company is currently projecting that mining operations will start in 2019 with ore processing being done in a "to-be-determined" foreign country.[60]

In September 2016, the Australian Government approved a pilot plant/mine by Northern Minerals to mine and process heavy REE. When operational, the mine will be

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[55] Cecilia Jamasmie, "Skepticism Grows Over North Korea's Massive Rare Earth Discovery," *Mining.com*, March 27, 2015, 1, http://www.mining.com/scepticism-grows-north-koreas-massive-rare-earth-discovery/ (accessed October 16, 2016).
[56] Hurst, 14
[57] Ibib.
[58] Jeff Yoders, "Rare Earths MMI: Japanese Investors Save Lynas Corp.," MetalMiner, http://agmetalminer.com/2016/11/08/rare-earths-mmi-japanese-investors-save-lynas-corp/ (accessed November 28, 2016).
[59] U.S. Department of the Interior, United States Geological Survey, *The Mineral Industry of Australia*, by Pui-Kwan t se, open-file report, U.S. Geological Survey (Reston, VA, 2009), 3.11.
[60] Australia's Northern Territory Government, Department of Mines and Energy Investment Attraction Division, *Nolans Project*, by Fiona Park (Darwin NT, Australia, 2016), 1.

the first heavy REE mine outside of China.[61] Politicians and business leaders hailed the mine as a key step towards breaking China's REE near-monopoly. Ironically, its largest stock holder is a state-owned Chinese company.[62] On November 23, 2016, Northern Minerals awarded the contract to build the facilities and infrastructure to another state-owned Chinese company.[63] It is too early to know China's true motivations in this mining venture, but with production not scheduled to start until 2021,[64] China will maintain its monopoly on heavy REE for the near future.

While REE explorations have found tremendous amounts of REE throughout the world, there are still few mining ventures that progressed enough to have a projected initial operational date. The estimated output of these mines, when and if they become operational, is not enough to end China's REE near-monopoly. And even the mines operating outside of China are struggling financially. China, regardless of methodology, keeps the prices of REE below the level that would keep other mining companies solvent. Unless there are changes to the cost-benefit ratio of the REE industry, companies will continue to manufacture high-tech items in China, and more companies will move manufacturing to China for both commercial and military components.

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[61] Andrew Topf, "First Heavy Rare Earths Mine in Australia Gets Pilot Plant Approved," Mining.com, September 18, 2016, http://www.mining.com/first-heavy-rare-earths-mine-australia-gets-pilot-plant-approved/ (accessed on October 1, 2016)
[62] *Ibid.*
[63] Filip Karinja, "Sinosteel MECC Selected by Northern Minerals as EPC Contractor for Browns Range Pilot Plant," http://finfeed.com/juniors/ntu/sinosteel-mecc-selected-northern-minerals-epc-contractor-browns-range-pilot-plant/20161123/ (accessed November 25, 2016).
[64] Andrew Topf, "First Heavy Rare Earths Mine in Australia Gets Pilot Plant Approved."

Chapter 2: Equipoising the Offset Mindset (Is the Technology aspect of the Third Offset even possible?)

"The 'offset' strategies [were] developed by national security thinkers in the 1950s and 1970s to ensure our military's superiority. . . . As we see those advantages begin to erode, I've asked [the DoD] to move forward with an initiative to develop a third, game-changing offset strategy." Secretary of Defense Chuck Hagel[1]

Section 1: The Offset Strategies

"People don't change when you tell them there is a better option. They change when they conclude they have no other option." Thomas Freidman[2]

An Offset Strategy is a strategic capability advantage that overcomes a separate strategic capability disadvantage. Offset Strategies are most commonly associated with technological advancements in equipment that offset numerical advantage. Harold Brown, Secretary of Defense from 1977 to 1981, stated in the FY1982 DoD authorization request: "Technology can be a force multiplier, a resource that can be used to help offset numerical advantages of an adversary. Superior technology is one very effective way to balance military capabilities other than by matching an adversary tank-for-tank or soldier-for-soldier."[3]

The *First Offset Strategy* was President Eisenhower's *New Look Strategy.* This strategy looked to adapt the U.S. nuclear advantage by developing the tactical application of nuclear weapons to offset the conventional warfare advantage of the Soviet bloc. While a direct war between the U.S. and Soviet Union never occurred, the U.S. did fight in Korea and Vietnam where the First Offset failed to achieve the Administration's desired outcome. The U.S. nuclear advantage was temporary, and by the mid-1960s, the

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[1] Chuck Hagel, "Defense Innovation Days Opening Keynote," (Speech, Washington D.C., January 28, 2015) Department of Defense, http://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies (accessed September 29, 2016).
[2] Thomas Freidman, *The World is Flat: A Brief History of the Twenty-First Century*, New York: Farrar, Straus and Giroux, 2005.
[3] U.S. Department of Defense, *Annual Report for Fiscal Year 1982*, by Harold Brown, Report of Security of Defense to Congress (Washington, DC, 1981), X.

Soviet Union achieved approximate parity. By the 1970s, the DoD officially acknowledged to Congress that the U.S. and Soviet tactical and strategic nuclear capabilities were "essentially equivalent," which signaled the end of the First Offset, and beginning of the Second.[4]

The U.S.'s *Second Offset Strategy* focused on creating high-tech, precision weapons, and systems that multiplied U.S. high-tech weapons' combat effectiveness like Global Positioning Satellites (GPS); Intelligence, Surveillance, Reconnaissance (ISR) platforms; and space-based communication.[5] Even though these products were envisioned in the height of the Cold War, Dr. Andrew Davies points out that the United States executed the Second Offset transformation during the time period that the Soviet economy was crumbling, and "to a large extent, the U.S. had the field to itself."[6] Even though the 1991 Gulf War shocked the world with the capabilities of the Second Offset Strategy, the Gulf War pitted the U.S. against a third world country—not a technological peer or near-peer adversary. Today, many of these systems are commonplace in modern militaries and the remainders are quickly being integrated.

None the less, in November 2014, the Department of Defense announced the new Third Offset Strategy. A key part of this strategy is based on the first two offset ideas that the U.S. can create (Second Offset) and keep (First and Second Offset) a cutting-edge

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[4] Harold Brown, "FY 1980 Budget, FY 1981 Authorization request and FY 1980-1984 Defense Programs", Report to Congress, January 25, 1979: 80

[5] William J. Perry, "Desert Storm and Deterrence," Foreign Affairs, Vol 70, Issue 4 (Fall 1991): 68-69, https://www.jstor.org/stable/20044194 (accessed October 1, 2016)

[6] Andrew Davies, "The Fallacies of the "Third Offset Strategy,"" RealClearDefense, August 4, 2016, http://www.realcleardefense.com/articles/2016/08/04/the_fallacies_of_the_third_offset_strategy_109668.html (accessed October 2, 2016). Dr. Andrew Davies, formally of the Australian Department of Defense, is the current Director for Defense and Strategy Program for the Australian Strategic Policy Institute. An augment can also be made that the Soviet attempt to keep up with the Second Offset, specifically SDI, caused the Soviet Union's economy to crumble.

technological advantage that will provide a decades-long competitive advantage and will deter or win the next war.[7]

Deputy Secretary of Defense Bob Work best summarized the Third Offset Strategy as:

> "significant investments in our nuclear enterprise; new space capabilities; advanced sensors, communications and munitions for power projection in contested environments; missile defense; and cyber capabilities. We are also investing in promising new technologies, including unmanned undersea vehicles; advanced sea mines; high-speed strike weapons; advanced aeronautics; from new engines to new, different types of prototypes; electromagnetic rail guns; and high-energy lasers."[8]

While all three offset strategies faced fiscal shortfalls, political uncertainties, and technological challenges, the *Third Offset Strategy* will be executed in a globalized but fractured multi-polar environment, not the unified bi-polar world of the Cold War.

Section 2: The Future of United States' Third Offset

> "An ant on the move does more than a dozing ox." Lao Tzu

The common, or "common sense," viewpoint is that the U.S.'s first two offset strategies had to be successful since they deterred a war with the Soviet Union. But, is this thinking a fallacy of consequence? Did military superiority win the Cold War? Did the U.S. even achieve military superiority? Strategic thinkers like Andrew Davies and others believe that the U.S. has taken the wrong lesson learned from the first two offsets and, thus, the *Third Offset Strategy* is destined to fail.[9]

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[7] Sydney J. Freedberg, Jr., "SecDef Carter Predicts His Reforms Will Endure," Breaking Defense, http://breakingdefense.com/2016/07/pentagon-reforms-will-endure-under-next-president-secdef-carter/ (accessed September 4, 2016).

[8] Bob Work, "The Third U.S. Offset Strategy and it Implications for Partners and Allies," Speech, Washington D.C, January 28, 2015, U.S. Department of Defense, http://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies (accessed September 6, 2016)

[9] Director of the Defence and Strategy Programs at the Australian Strategic Policy Institute

The nature of technological innovation has changed since the DoD implemented first two offset strategies. Secretary of Defense (SecDef) Hagel succinctly summarized, "Today, a lot of groundbreaking technological change–in areas such as robotics, advanced computing, miniaturization, and 3D printing–comes from the commercial sector."[10] The fact that R & D comes from commercial development rather than from the military-industrial-congressional complex is a radical departure from the first two offsets and the *Third Offset Strategy*. Many senior leaders and strategic thinkers emphasize this as a flaw in the *Third Offset Strategy*. Davie's emphasizes that "waiting for a 'once in a generation' capability breakthrough isn't likely to be a winning strategy,"[11] while a senior Military officer stated, "reliance on achieving the dominance of the new Third Offset Strategy is not possible."[12]

Even if R&D is contained in the U.S. military-industrial-congressional complex, manufacturing has become a globalized process and creates a new issue—technology bleeds. Deputy Security of Defense Bob Work even highlighted this issue in a December 2015 speech: "some of the potential competitors are letting us do the research and development, then they steal it from us through cyber theft, and they go right to development, rather than spending their own resources on Research and Development."[13] Davies contends that the highly successful Chinese espionage has already siphoned enough information about the F-35, B-2, nuclear weapons, radars, etc. to ensure that these systems will not achieve a multi-decade advantage.[14]

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[10] Hagel, "Defense Innovation Days Opening Keynote"
[11] Andrew Davies, "The Fallacies of the 'Third Offset Strategy.'"
[12] Non-attributable due to the NDU Non-attribution policy available at http://www.ndu.edu/portals/59/Documents/AA_Documents/AA%205.00.pdf
[13] Bob Work, "The Third U.S. Offset Strategy and it Implications for Partners and Allies."
[14] Andrew Davies, "The Fallacies of the 'Third Offset Strategy.'"

An additional aspect of technology bleed is the previously discussed forced downstream manufacturing. By using economic factors such as low labor costs, access to raw materials, and access into a home market, some countries coerce foreign companies to relocate their manufacturing to their nation. While this is a deliberate violation of WTO rules, and the WTO has ruled against countries guilty of this action, it is difficult to prove. Once the manufacturing has moved, the new country uses the rights and powers of state sovereignty to know what precisely the company is manufacturing and the details on how it is manufactured. A current example is the iPhone. In March of 2016, the U.S. Justice Department lost a court case to force Apple to unlock the encrypted secured iPhone belonging to the suspected San Bernardino terrorist that the Justice Department believed had information on other terrorists and possible other terrorist events.[15] Apple argued that opening the iPhone would violate its Freedom of Speech and would lead to governments abusing the ability to unlock iPhones. Apple did not unlock the phone nor did they assist the U.S. government. Yet, in January of 2016, a similar situation occurred in China when the Cyberspace Administration of China ordered Apple to install a security patch on all iPhones sold in China allowing the Chinese government to access the phone on their own without Apple assistance; Apple complied.[16]

[15] "Breaking Down Apple's iPhone Fight with the U.S. Government," *New York Times*, March 21, 2016, http://www.nytimes.com/interactive/2016/03/03/technology/apple-iphone-fbi-fight-explained.html (accessed October 16, 2016).

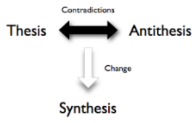
[16] James Wilkinson, "Why Did Apple 'let China See Its Secret Data for Security Checks' but Is Now Refusing to Unlock San Bernardino Terrorist's iPhone?" *Daily News, UK*, February 20, 2016, James Wilkinson, "Why Did Apple 'let China See Its Secret Data for Security Checks'," *United Kingdom's Daily Mail, The Mail on Sunday and Metro Media Group*, 20 February 2016, http://www.dailymail.co.uk/news/article-3456654/Apple-refusing-unlock-San-Bernardino-terrorist-s-phone-ask-did-seemingly-let-China-secret-data-security-checks-year.html (accessed October 16, 2016).

Former Secretary of Defense Hagel's Third Offset Strategy initiative, which was also supported by his successor, Secretary of Defense Carter, is focused on creating future deterrence on an unstated, and maybe even unknowable, future threat. Since this approach is a capabilities topic and not foreign policy, the new U.S. presidential administration, specifically Secretary of Defense GEN(R) Mattis, will almost certainly endorse it. However, the level of priority that they will assign to the Third Offset is currently unknown as is the directional type of these new technologies—from personnel items to major weapons systems. While it is impossible to predict the specific technological advancement that the Third Offset will bring, it is possible to describe them as electronics that are physically small, complex, costly to research and develop, and difficult to manufacture. Since REE are the key element for modern electronics and miniaturization, they will undoubtedly be a critical part of the Third Offset. And due to China's leverage of its REE near-monopoly to coerce companies to move high-tech manufacturing to China where the Chinese government will have free access to the intellectual property behind these high-tech item—REE will be a critical vulnerability, unless there are changes to the cost-benefit ratio of the REE industry.

Chapter 3: The United States' Third Offset in China's Rare Earth Elements Near-Monopoly World.

"The Middle East has Oil, and China has Rare Earth" Deng Xiaoping in 1992.[1]

Section 1: The Synthesis: The Collision of the Thesis (*Third Offset*) and Its Antithesis (REE Near-Monopoly)



Hegelian Theory of Dialectics

As the world's current and future commercial and military complex consumes an increasing amount of REE, China's near-monopoly and success in relocating high-tech manufacturing to China will allow it to maintain pace with technological advancements without spending its own capital on R&D. Left unaddressed, China will continue to use price manipulation as well as buying mines and relocating REE manufacturing operations to maintain its REE near-monopoly. This near-monopoly will continue to allow China to coerce companies into moving manufacturing to China regardless of the WTO rulings. Once the manufacturing has moved to China, the Chinese government will have full access to the intellectual property behind some the most advanced technologies in the world.

This migration of high-tech intellectual property to the Chinese government is a direct threat to the United States' ability to achieve the technological advantage goal of the Third Offset Strategy. If the current tech manufacturing environment caused by China's REE near-monopoly remains unchanged, China has the real potential to achieve military parity with the U.S. at a fraction of the cost. To counteract the threat that China's REE near-monopoly created, the United States needs a deliberate, dedicated strategy that

[1] JianJun Tu, "An Economic Assessment of China's Rare Earth Policy," *The Jamestown Foundation's China Brief* Vol X, Issue 22, November 5, 2010, 3

uses all aspects of national power-Diplomatic, Informational, Military, and Economic (DIME).

Section 2: Targeted use of the Diplomatic, Information, Military, and Economic on the Military-Industrial-Congressional Complex.

"Reliable access to the material it needs, such as rare earths, is a bedrock requirement for DOD." 2016 U.S. Government Accountability Office (GAO) report.[2]

Historically, nations conducted military technological R&D and manufactured their equipment internally. This trend began to change with the end of colonialization, along with the associated acquisition of resources and the beginning of globalization with the western countries shifting from manufacturing to service economies. One of the first signs of military-industrial-congressional complex resource protectionism occurred in 1973 when Congress added specialty metals, including REE, to the 1941 Berry Amendment which required DoD acquisition from domestic sources only.[3] Under the Berry Amendment, 100% of all components that included REE had to be domestic.

Either coincidentally or consequently, after the closure of the Mountain Pass REE mine, Congress removed the specialty metal requirement from the Berry Amendment and incorporated the requirement into National Defense Authorization Act, Section 10 U.S.C. 2533B, granting a universal exemption for electronics, commercial items, and items with "small amounts of non-compliant specialty metals" of less than 2% by mass.[4] The new language also added "qualifying countries" to the domestic production requirement. This change in the law functionally exempted REE from the domestic requirement for

[2] U.S. Government Accountability Office, *Rare Earth Materials: Developing a Comprehensive Approach Could Help DOD Better Manage National Security Risks in the Supply Chain*, Report to Congressional Committees, pt. GAO-16-161 (Washington, DC, 2016), 24.
[3] Congressional Research Service, *"The Specialty Metal Clause: Oversight Issues and Options for Congress,"*, 1
[4] Ibib, 10

specialty metals. But, the 2% clause could actually help China acquire more U.S. manufacturing since an REE magnet would be greater than 2% REE by mass and thus banned, but the next higher component, like a gyroscope, would have less than 2% REE by mass and thus exempted.

A simple approach would be to eliminate the universal exemption and require all military items be constructed with U.S. or "qualifying countries" components or require a specific waiver from Congress. Many components, however, are used both for civilian and military applications. The cost of running two assembly lines, one for military and one for the larger commercial sector, would be beyond the financial gain of the military contract. Plus, some component makers may not even know the end user of their component.

A simple example is a maker of an REE magnet might sell its magnet to a company that makes gyroscopes, who sells the gyroscopes to an avionics maker, who sells the avionics to both commercial and military equipment manufactures.[5] Then, the same REE magnet maker could sell the REE magnet to manufactures of headphones, hard drives, cordless tools, etc. The globalized supply chain of the modern world makes 100% domestic or "qualifying countries" challenging. Even knowing where all the components are manufactured is difficult. In 2007, Lt Gen Donald Hoffman, USAF, testified to congress in reference to specialty metals that it took a team "over 2,200 man hours to review 4,000 parts" of the Advance Medium Range Air-to-Air (AMRAM) missile.[6]

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[5] Congressional Research Service, *"The Specialty Metal Clause: Oversight Issues and Options for Congress"*, 14

[6] U.S. House Committee on Air and Land Forces Subcommittee, *Air Force and Army Airlift*, 110th Cong., 1st sess., 2007, H. Hrg. 110-28, 25.

Since many items and materiels required for Third Offset Strategy R&D and production have no current U.S. source, an immediate elimination of the universal exemption would have no impact in the REE-created technology bleeds to China. Without the universal waiver, the DoD would have a massive paperwork endeavor to get waivers that Congress would have to approve since there are no other current sourcing solutions. Yet a law that removes the universal exemption in 10 years would encourage new domestic REE resourcing and REE manufacturing. But, with the low REE prices coming out of China, both on raw REE and the downstream products, it is unlikely that U.S. companies could afford the billions of dollars needed to create domestic REE sources even with the lure of U.S. military contracts. These new REE sources would be more expensive than other commercial products out of China leaving the military, which has a habit of canceling projects, as the only customer and only as long as Congress doesn't change the law, again. On its own, the 10-year encouragement is not enough to restart the REE domestic sourcing. Yet the government has provided other incentives for similar industries.

In 1986, the DoD was concerned that the U.S. would lose its entire semiconductor industry, which would require the Second Offset Strategy technologies to be reliant on foreign sources for its high-tech components. By 1988, the DoD, along with 14 U.S. semiconductor manufacturers, launched SEMATECH (SEmiconductor MAnufacturing TECHnology) a public-private partnership with DoD providing $1.7 billion in matching funds.[7] Within six years, the U.S. semiconductor industry was viable, and the DoD funding ended. While additional research into an REE version of SEMATECH are

[7] Larry Browning and Judy Shetler, *SEMATECH: Saving the Us Semiconductor Industry* (College Station: Texas A&M University Press, 200), 19.

warranted, it is unlikely to provide a sole solution. In the mid-1980s the issue was not resources nor manufacturing costs, but technical knowledge and manufacturing problems. With REE, the U.S. leads the world in REE technologies and manufacturing expertise, but lacks the raw REE material and has high manufacturing costs.

Changes to the specialty metal procurement rules and public-private partnership are not irrelevant. They are a vital part of any long term solution to prevent the technological drain to China caused by China's REE near monopoly. Unfortunately the previous results and current impact of China's REE near-monopoly are too great to be solved with a micro-level plan targeted at only the military-industrial-congressional Complex.

Section 3: Marco Diplomacy with the WTO

"We [U.S.] must enact permanent NTR [Normal Trade Relations] for China or risk losing the full benefits of the Agreement we negotiated, including broad market access, special import protections, and rights to enforce China's commitments through WTO dispute settlement." President Bill Clinton, March 8, 2000 shortly before the U.S. approved NTR for China.[8]

In 2015, the WTO ruled that China violated the WTO rules by using its REE near-monopoly to coerce companies to move high-tech manufacturing to China by reducing the export and threaten to stop the export of REE without restricting internal consumption. After appealing, China agreed to comply with the WTO ruling and lifted the limitations on all REE exports. Shortly afterward China imposed a tax on REE and other elements. The WTO does not ban taxing materials as long as the tax is on internal and external sales. In this case, China only taxed the exports of raw REE and does not tax

[8] William Clinton, "Message to the Congress Transmitting Proposed Legislation on Permanent Normal Trade Relations with China" (Washington D.C., March 8, 2000), Office of the President of the United States, http://www.presidency.ucsb.edu/ws/index.php?pid=58115&st=China+Trade&st1= (accessed December 29, 2016)

internal consumption nor the exports of manufactured components that contain REE. In July 2016, the United States filed another suit with WTO on China's taxation policy.[9] The 2013 case took three years to resolve, but the 2016 case might take longer which, in the meantime, will allow China to coerce manufacturing movement to China. While the world should continue to work the legal aspects inside the WTO, legal avenues alone will not solve the problem.

Section 4: Using the Diplomatic and Information Elements on REE Recycling

"Each technology requires a different recycling technique — what separates terbium [a REE] from light bulbs won't isolate neodymium [another REE] from a hard disk drive." Kathryn Free, Geobiologist NYU. [10]

In 2013, the western world recycling rates averaged 20% to 65% with the U.S. at 35%.[11] Projecting this ratio into REE recycling program gives the impression that if the world just started REE recycling it would end China's REE near monopoly even at the current recycling rates. Some environmental groups like the Netherlands' Green Academy state that 100% REE recycling of electronics would supply 10% to 15% of the world's REE demand.[12] Other organizations like New York University's (NYU) Scienceline state that 100 % recycling, although Germany is the world's leader in recycling at 65%, would fulfill 40% of the countries REE needs.[13] But REE have the

[9] Tim Worstall, "Us Sues China at WTO Over Minerals Export Taxes Again - and Is Likely to Win," Forbes, http://www.forbes.com/sites/timworstall/2016/07/14/us-sues-china-at-wto-over-minerals-export-taxes-again-and-is-likely-to-win/#699536985831 (accessed November 29, 2016).
[10] Kathryn Free, "The Future of Rare Earth Recycling," New York University's Scienceline: The Shortest Distance between You and Science, http://scienceline.org/2014/03/the-future-of-rare-earth-recycling/ (accessed December 26, 2016).
[11] OECD (2015), *Environment at a Glance 2015: Oecd Indicators* (Paris: OECD Publishing, 2015), http://dx.doi.org/10.1787/9789264235199-en (accessed December 29, 2016), 52.
[12] Jessica Marshall, "Why Rare Earth Recycling Is Rare (And What We Can Do About It)," University of Minnesota's ensia, https://ensia.com/features/why-rare-earth-recycling-is-rare-and-what-we-can-do-about-it/ (accessed December 29, 2016).
[13] Free, "The Future of Rare Earth Recycling."

same issue in recycling as they do with mining—REE are common at low concentrations but high concentrations are rare. Items with high concentration of REE, the ½ million pounds needed for F-35 program or 13,000 pounds for the Block Island Wind farm, will not be available for recycling for another 30 to 50 years. REE recycling does get a boost from medical scanning equipment as well as other equipment which contains REE that get upgraded before the designed end-of-life, and REE rechargeable vehicle batteries along with other REE items that get damaged. But the high concentration REE recyclable items are rare, not predictably consistent, and not sufficient to solely impact China's REE near monopoly.

Unlike normal recycled items like paper and aluminum, short life cycle products that contain REE—cell phones, computers, TVs, and fluorescent light bulbs—have very low concentrations of REE with cell phone REE only about 1% of mass.[14] Fortunately, these REE have already been stripped of the radioactive and toxic elements that they are bonded with in nature, but they are now bonded with other toxic chemicals like arsenic and mercury, both of which the World Health Organization has listed as two of the world's top ten pollutants, which increases the cost of recycling.[15]

Yet the one percent by mass ratio REE per cell phone is on par with the best REE mining locations. If the billion cell phones that are manufactured this year each replace a recycled cell phone the potential REE recapitalization would be 1,000 to 3,000 tons of REE, or about one percent to two percent of the world's yearly production. Like the

[14] Geological Society of London, *Rare Earth Elements* (London: Geological Society of London, 2011), https://www.geolsoc.org.uk/~/media/shared/documents/policy/Rare%20Earth%20Elements%20briefing%20note%20final%20%20%20new%20format.pdf (accessed December 28, 2016).
[15] World Health Organization, *Ten Chemicals of Major Public Health Concern* (Geneva: World Health Organization, 2010), http://www.who.int/ipcs/assessment/public_health/chemicals_phc/en/ (accessed December 29, 2016).

majority of natural, raw REE on earth, the billion cell phones are not at one place but spread across the world.[16] And one hundred percent of the people do not trade-in or recycle their old cell phones. In 2013, Nokia conducted extensive research and found that the majority of the people kept their old cell phone as a spare, twenty-four percent gave it to friends and family, and only eighteen percent traded it in, recycled it, or discarded it.[17]

Even with all the difficulties associated with consolidating the electronics, separating the REE, and properly disposing of toxic elements, recycling and urban mining could be a viable alternative if the price of REE increases or the availability of REE decreases. Still Honda, Hitachi, and Solvay currently have a recycling infrastructure with several other companies in the process of building recycling centers.[18] In 2011, the USGS estimated the world's total REE recycling accounted to "near-zero," and stated that unless REE prices dramatically increase, new technologies become available, or recycling is mandated by law, REE recycling will not significantly alter the current REE production environment.[19] The key issue with REE recycling is economics—it is cheaper and easier to buy new. As long as China keeps REE prices low, or low enough, current REE recycling programs will have little effect on China's control of the REE market.

While there are informational programs and diplomatic actions like government regulations and international agreements, these actions are far from a solution and will struggle even with government subsidies, unlikely in the current political climate. In 2015, the European Union (EU) estimated the total REE recycling equates to less than

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[16] U.S. Department of the Interior, United States Geological Survey, *Mineral Commodity Summaries 2016*, 135

[17] Fanny Verrax, "Recycling Toward Rare Earth Security," in *The Political Economy of Rare Earth Elements: Rising Powers and Technological Change* (New York: Palgrave Macmillan, 2015), 164

[18] *Ibid.*,167

[19] U.S. Department of the Interior, United States Geological Survey, *"Rare Earth Elements—End Use and Recyclability"* by Thomas G. Goonan, open-file, US Geological Survey (Reston, Virginia, 2011), 7, 12

one percent of EU REE demand even with strict recycling laws, existing subsidies, and a massive information campaign.[20] The U.S. and the world should continue to maximize recycling and develop new REE recycling technologies, but recycling alone will not solve the problem.

Section 5: An Economy of Coercive Measures: Tariffs and Foreign Ownership.

"Economic control is not merely control of a sector of human life which can be separated from the rest; it is the control of the means for all our ends." Friedrich Hayek, *The Road to Serfdom*.[21]

In 2013, the Intellectual Property (IP) Commission recommended to Congress that the U.S. impose a tariff on all Chinese products to cover 150% of the cost of China's IP theft.[22] The proposal was never adopted and would have violated WTO rules, but would a tariff on raw REE or REE downstream products result in the end of China's REE near-monopoly and China's IP theft from REE supply manipulation? Tariffs are principally imposed for the protection of local businesses. Since no REE mine is currently in business in the U.S., a tariff on raw REE would increase the cost of REE in the U.S. with the intent to create a profitable REE mining industry. This action has two issues. The first is the cost of building mining facilities. An existing mine, like Mountain Pass, required half-billion dollar to begin operations, and Russia recently invested one billion dollar just to start building an REE mine. Few financiers are willing to invest this much capital in a long term venture based solely on an artificial price that could end by the next election or WTO ruling. Making the situation worse is the half-billion dollars

[20] Monique Vanhaeren, "Erean Report Summary," European Union's Community Research and Development Information Service, http://cordis.europa.eu/result/rcn/181390_en.html (accessed December 29, 2016).
[21] Friedrich Hayek, *The Road to Serfdom*, (Chicago: University Of Chicago Press, 2007), 95.
[22] The Commission on the Theft of American Intellectual Property, "IP Commission Report," *The National Bureau of Asian Research*, May 2013: 84

lost when Mountain Pass REE mine went bankrupt last year, only a year after re-starting operations.[23]

The second issue is the increased cost of REE. U.S. companies might be willing to pay the extra cost of REE if a reliable local source of REE was available. Unfortunately, it would take years to restart the existing mine at Mountain Pass and a decade to start a new mine and extracting plant. Fears that China could react by limiting REE exports, which was the main reason that many companies originally moved REE downstream manufacturing to China, could force the few remaining companies to move to China.

A tariff on the REE downstream manufactured product is another possibility. Unlike raw REE, a tariff on REE manufactured goods would significantly impact other countries, i.e. Japan, Korea, Taiwan, and EU, or target only China, which would certainly bring a WTO complaint and possibly a trade war. This tariff could persuade businesses from moving to China if they still had access to REE. After all, a company that builds a REE item must have access to REE, or it will go out of business. Enticing a manufacturer to move out of China is dubious, especially if the company has no rival in the U.S. who could take advantage of not paying the tariff and sell at a lower cost. This tariff could create new businesses and manufacturing in the U.S., which would take years to build the manufacturing infrastructure, but they would still need access to REE.

Whether a tariff is applied to the raw REE or a REE downstream product, it has little prospect of creating mining or industries that do not currently exist in the U.S. However, a tariff could create a trade war that would force more businesses to move to

[23] Canada Minister of Natural Resources, *The State of Global Rare Earths Industry: A review of market, production, processing and associated environmental issues*, 20.

the REE source, China. Simply, China's REE near-monopoly is too dominate for a tariff to break.

There are other aggressive economic approaches—import bans, limits on or the elimination of foreign ownership of U.S. companies and mining. Import bans are rare in modern times and would not help with ending China's REE near monopoly since, without internal mining operations, banning REE imports would result in the U.S. having no REE for years until local mining operations could restart/ start. Banning REE product would only cripple the U.S. technology sector since almost no modern electronics are free of some type of Chinese made REE component.

Limiting or eliminating foreign ownership of U.S. mining operations might have helped the U.S. and other nations in the past, but currently enacting this policy, which the U.S. and other nations have already done defacto by individually denying China's companies from buying mining sites, would have no effect on China's REE near-monopoly. Limiting or eliminating foreign ownership of U.S. manufacturing would dramatically, negatively impact the U.S. economy by stopping all foreign investment and development in the U.S.

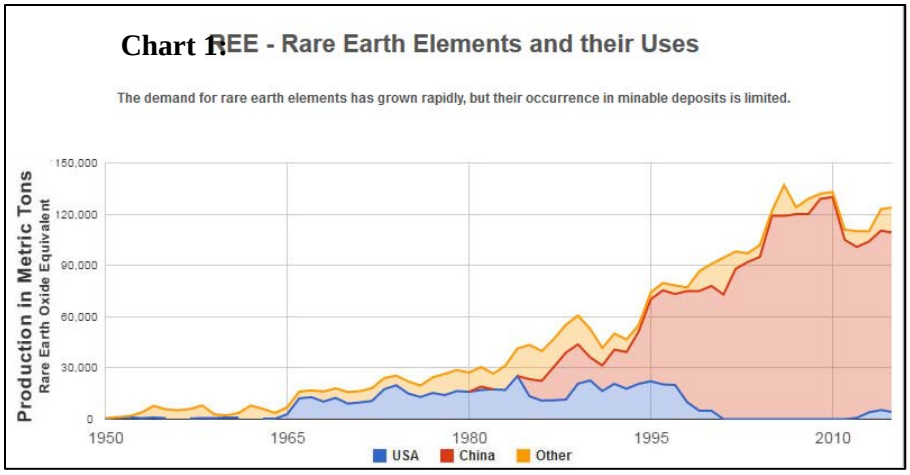
The implementation or the threat of aggressive economic cohesive measures would have little impact China's REE near-monopoly. Long term, it would only strengthen China's REE manipulation of business.

Section 6: Using the Diplomatic and Information Elements for a Level Playing Field.

"Approximately 80 percent of international trade is affected by standards and the health, safety and environmental regulations that incorporate them." Dr. Arden Bement, former Deputy Undersecretary of Defense for Research and Advanced Technology.[24]

REE mining has three distinct eras (see Chart 1). From the discovery of REE until the mid-1960s, all raw REE were byproducts of other mining activities. The 1960's brought affordable color TVs, made possible by REE.[25] The explosion in demand for REE brought the second era of dedicated REE mining operations on top of the first era. The next era, starting in the 1980s, is a combination of two events. The first was the technology explosion of both military (Second Offset Strategy) and civilian electronics that REE made possible that tripled the demand for REE. As the REE demand skyrocketed, the IAEA changed the classification of Thorium. The classification change itself would have only dramatically increased the cost of REE, and the associated electronics that use REE, if all countries abide by the IAEA treaty. But in 1981, China issued its "Let Water Flow Rapidly" policy that nearly eliminated the environmental requirement aspects of mining, which created an uneven playing field where China kept prices low while the rest of the world had to either significantly increase prices, go out of business, or both. Everyone else went out of business.

[24] Arden Bement, "National Electrical Manufacturers Association" (speech, National Electrical Manufacturers Association Board of Governors, Rosslyn, VA, July 18, 2002), https://www.nist.gov/speech-testimony/national-electrical-manufacturers-association (accessed February 19, 2017)
[25] U.S. Department of the Interior, United States Geological Survey, *Rare Earth Elements-Critical Resources for High Technology*, 1.



[26]

Since then, many non-Chinese companies have tried to get back into the market, but the low cost of Chinese REE and the growing environmental requirements of mining REE have either closed them down, like Mountain Pass U.S., or have put them in risk of closing down, like Lynas, Australia.

There are two methods of recreating the level playing field. The first is to use the UN, IAEA, WTO, and other international government organization to put pressure on China to comply with the international environmental standards. But what kind of pressure could these organizations or the world community put on China? More precisely, what kind of pressure *would* they be willing to put on China? Globalization and international trade is a two-way street—hurt them, hurt yourself—so the only pressure will be the threat of action. This will play directly into China's hands. They can slowly increase REE prices and reduce production, i.e. exports, in the name of environmental compliance. This could be a multi-decade process that China could use to coerce more manufacturing to move to China or, since China has gained the intellectual property, replace the international businesses with Chinese-owned manufacturing.

[26] Hobart King, "REE – Rare Earth Elements and their Uses."

The second method of creating the level playing field is to change the environmental handling requirements of Thorium. Thorium is a naturally occurring, weakly radioactive element. Under U.S. and most western countries' environmental laws, once the REE, and thus the Thorium, is separated from the raw ore—or mining byproduct—it has to be treated as radioactive source materiel, which creates additional costs that mining companies cannot afford. Unlike Uranium, Thorium is not fissionable so it cannot meltdown or be used in a weapon. When it decays, it releases an Alpha radiation particle that cannot penetrate skin, soil, or anything. Since the Alpha particles can only travel a few feet, once the Thorium is encased in anything, the radiation is isolated. Thorium decays with a half-life of fourteen billion years. That means that if a person held one kilogram of Thorium, the amount of decaying particles is less than the amount of Thorium in the food that a person typically eats in a day. Naturally occurring Thorium is not as dangerous as naturally occurring Uranium, which is the least dangerous version of Uranium by orders of magnitude, yet the handling requirements are the same. Nevertheless, mining operations should not ignore the Thorium byproduct, but it does not have to be handled to the same standard as Uranium.[27]

A change in the Thorium handling and storage requirements would not only jumpstart REE mining, it would also bring back the first era of REE production—REE extraction from mining byproducts. This type of production, separating REE from Iron ore by-product, is still the current basis for China's REE production.[28] The mining byproduct technique can also be used in other mining operations. In the United States, the

[27] U.S. Environmental Protection Agency, *Multi-Agency Radiation Survey and Site Investigation Manual*, EPA 402-R-97-016, Rev. 1 (Washington, DC, 2000), C13
[28] Frik Els, "Chinese Rare Earth Giant Born," *Mining.com*, December 16, 2014, http://www.mining.com/chinese-rare-earth-giant-born-62354/ (accessed February 20, 2017).

amount of REE with its associated Thorium that mining operations discarded as waste from phosphate mining along could supply the world with a significant proportion of global requirements.[29] This seems like a simple solution and yet, with the current environmental regulations on handling radioactive materials, the cost to benefit ratio of separating the REE from the waste byproduct is not commercially viable. Thus mining companies just leave the REE and the Thorium in the raw waste byproduct where it is not, legally, necessary to treat as radioactive material let alone a source materiel.

If the IAEA and the EPA reduce the handling and storage requirements of Thorium, it would re-energize REE mining operations all over the world. While the environmental requirements of mining REE would be still be significantly higher than in China, this one act would place REE mining outside of China in the economically viable zone. However, even if China's monopoly ended tomorrow, it would not relocate the manufacturing facilities that have already moved to China.

[29] Patrick McLaughlin et al., "Rare Earth Elements in Sedimentary Phosphate Deposits: Solution to the Global REE Crisis?," *ScienceDirect: International Association for Gondwana Research* 27, no. 2 (February 2015): 1, http://www.sciencedirect.com/science/article/pii/S1342937X14003128 (accessed February 20, 2017).

Conclusion:

"富不过三代" (Wealth never survives three generations.) Ancient Chinese proverb.

In 1992, China's General Secretary Deng Xiaoping publicly and correctly likened China's REE with Middle East oil. The Middle East did not and does not control the world's oil market, but is a major player that has significant influence in both the price and availability of oil. Twelve years of the "Let Water Flow Rapidly" policy of little to no regulation, environmental protections, and safety considerations had elevated China from an REE unknown to the level of influence greater than that the Middle East has with oil. Unlike the Middle East oil nations who raised the price of oil and gained extreme wealth as western countries struggled to meet new environmental laws in domestic oil production, China kept its prices low as western countries struggled to meet new environmental and security laws in domestic REE production. The prices remained low enough that all significant external competition to Chinese REE mining operations went out of business by 2002, giving China a REE near-monopoly and control of the world's REE market.

In the fifteen years since, the Chinese government has successfully incorporated its REE near-monopoly into its grand strategies. China has sparingly used its REE near-monopoly, stopping and threatening to stop REE exports, on diplomatic issues. Instead, China has focused its REE near-monopoly on the economic front, coercing companies to move manufacturing to China, and thus acquiring it high-tech intellectual property. This flow of technology to China is a direct threat to the goals of the Third Offset Strategy—a multi-decade technological military advantage.

China's control of the REE market is not based on access to resources; it only has thirty-five percent of the world's REE reserves. China's control is based on resolve—the willingness to sacrifice short-term profits and potentially long-term, environmental effects for technological gains and the ability to fight wars "under high technology conditions."[1] As China nears the third generation of its REE strategy, the western world must muster the determination to match China's resolve.

To offset China's thirty-seven years of a highly successful REE market manipulation, it will take a comprehensive strategy that incorporates all elements of the national power, DIME, several years, and the *will* to do it, if the U.S. is going to achieve the *game-changing goal* of the Third Offset Strategy. Fortunately, the Third Offset strategy will also take years of R&D before its technological achievements are ready for production. So, there is time for DIME.

Diplomatic: "Kicking a man when he is down"

China is certainly taking advantage of their REE near-monopoly, but it is important to acknowledge that they were not solely responsible for the "man being down," only the kicking afterward. So, the diplomatic actions against China needed to safeguard the Third Offset technology should focus on China's abuse of their REE near-monopoly, not that they have the REE near-monopoly. While the temptation to punish them for previous abuses seems warranted, this will hurt U.S. tech businesses and the U.S.'s ability to develop Third Offset technologies by increasing REE costs and decreasing REE availability. The U.S. and other nations need to continue to work inside the WTO and other international organizations to ensure that Chinese REE flow to

[1] Laurie Burkitt, Andrew Scobell, and Larry M. Wortzel, *The Lessons of History: The Chinese People's Liberation Army at 75* (Carlisle, PA: Strategic Studies Institute, 2003), 214.

businesses around the world are based on a level playing field where companies outside of China have the same ability to buy REE as internal companies, as required by the WTO rules. Outside of this, there is little internationally diplomatic directed or targeted pressure on China that will help end their REE near-monopoly.

While diplomatic actions on China will have little effect, international diplomacy is critical to end China' REE near-monopoly and its associated hold on REE manufacturing, since it was an international organization that helped "put the man down." Specifically it was the IAEA, and the U.S. EPA classification of Thorium as a Source Materiel requiring Thorium handling at the same level as Uranium. Changing the IAEA and EPA classification, or unilaterally having only the EPA change its classification, of Thorium to a new, less restricted classification would re-energize the world's REE mining operations. There is no need to eliminate Thorium from all environmental laws like China has done. Thorium should still be considered a hazardous substance, just not to the same standard as Uranium. This action alone would make REE mining viable and set the conditions to end China's REE near-monopoly before the Third Offset technologies are ready for manufacturing. However, this would not move REE downstream manufacturing already established in China back to U.S. and allied nations.

Information: "I only know what I know"

Historically, nations kept their strategic vulnerabilities secret to avoid publicizing any acknowledged weaknesses. The fact that China has control of REE and the REE manufacturing sector is neither a secret to China nor other governments around the world. For the general public, it is little-known and less discussed, even in governmental circles. It is almost like it is a source of embarrassment and the only way to handle it is to ignore

the problem. Yet, the public needs to know the problem so they can support the solutions of reclassifying Thorium and dedicating to recycling REE products.

Getting thorium reclassified sounds like a purely scientific endeavor with an international diplomacy flare. But, right or wrong, environmentalism has become a populist movement. Without an information campaign which explains that, while Thorium is radioactive, it is not a nuclear boogie man and should not be treated the same as Uranium but as a relatively minor environment issue. Without this dialog, Thorium reclassification will not get the public and political support that needed for the IAEA and EPA to make a change.

Recycling is a key topic and a source of much publicity throughout the world. A governmental information campaign based on both the environment and the need for REE as an aspect of national security and pride would be relatively inexpensive and publicly popular. Increases in recycling of REE would help correct the situation, but only marginally. The campaign itself, however, would bring focus to the importance of REE and would assist in getting public support for other aspects of the REE strategy and may assist with private industry raising funds for REE enterprises.

Military: "Money is a weapon system."

The intellectual property bleeds caused by China's leverage of its REE near-monopoly to force REE downstream industries to move their manufacturing to China is a direct threat to the Third Offset Strategy goal of a multiple decade technological advantage. The U.S. must alleviate this threat, not with force but with one of the DOD's most powerful weapon: money. Specifically, the DoD can use the power of defense

contracts to build the military equipment created for the Third Offset Strategy from companies in the United States or allied nations.

An immediate elimination of the universal exception for electronics, commercial items, and items with "small amounts of non-compliant specialty metals" granted in Section 10 U.S.C. 2533B of the National Defense Authorization Act[2] would be impractical given the current and near future REE supply issues. A more effective method would be an immediate law that repeals the universal exception on a specific future date. This will allow manufacturers the time to create new or move existing manufacturing centers to the U.S. and allied nations. Yet the manufacturers will still need access to the REE. Unilaterally taken, this change to the National Defense Authorization Act, could create a negative impact to the Third Offset technologies by not having an authorized vendor. Without an authorized vendor, the Defense Department would have to draft and fund thousands of exceptions to policy statements for congressional approval. Yet, if enacted as a part of a comprehensive strategy, it would provide the financial incentive to jumpstart REE downstream industry in the U.S. and allied countries.

Economic: "It's the supply and demand"

Ironically, it was not solely an economic act that allowed China to gain its REE near-monopoly level to coerce companies to move REE downstream manufacturing to China, but economics was the reason that U.S. and other western countries stopped mining REE. The combination of China's inexpensive REE production under the "Let Water Flow Rapidly" policy and the high cost of production outside of China due to environmental and security requirements for handling Thorium created China's REE

[2] Congressional Research Service, *"The Specialty Metal Clause: Oversight Issues and Options for Congress,"* I & 10

near-monopoly. The U.S. or other nations' use of, or threat, of tariffs and other coercive economic actions against China would be unproductive, since there are no other sources that can support the current demand—China's REE near-monopoly controls the world supply of REE. The economic focus needs to be promotional and not punitive.

The economic aspect of the comprehensive strategy is the reduction of barriers that makes mining of REE financially unviable and provides an incentive to re-establish REE downstream industry in the U.S. and allied nations. The Thorium classification change is one example of a barrier that needs modification. Equally important, is the commitment not to create new or revised rules and regulations that negatively affect REE mining. The best economic incentive to spur domestic REE mining and downstream industry outside of China is the previously discussed military contracts to manufacture REE technologies.

Final Thoughts:

To safeguard the Third Offset technologies from China's REE influence, there are two separate but critical tasks the U.S. must accomplish—break China's REE near-monopoly and bring some of the REE downstream industry back to the U.S. and other "qualified nations." The U.S. must accomplished both tasks if the U.S. is going to achieve the *game-changing* goals of the new Third Offset Strategy. The old cliché, "all of the above approach" is not appropriate since many of the "solutions"—e.g. tariffs and blocking foreign investment—will make the situation worse. But a comprehensive strategy that incorporates all aspects of national power (DIME) can revitalize both domestic REE mining and REE downstream manufacturing, which will eliminate China's

REE near-monopoly avenue for obtaining the intellectual property behind the Third Offset technology.

Bibliography

Abraham, David S. *The Elements of Power in the Rare-Metal Age*. New Haven: Yale University Press, 2015.

Adams, Rod. "Is Offshore Wind Finally Ready to Serve U.S. Power Needs?" *Forbes*, August 16, 2016. http://www.forbes.com/sites/rodadams/2016/08/17/is-offshore-wind-finally-ready-to-serve-us-power-needs/#3dd8a79b5468 (accessed October 11, 2016).

Aharone, Ezrah. *Pawned Sovereignty: Sharpened Black Perspectives on Americanization, Africa, War, and Reparations*. Bloomington: Authorhouse, 2003

Australia's Northern Territory Government. Department of Mines and Energy Investment Attraction Division. *Nolans Project*, by Fiona Park. Darwin NT, Australia, 2016.

Bement, Arden. "National Electrical Manufacturers Association." Lecture, National Electrical Manufacturers Association Board of Governors, Rosslyn, VA, July 18, 2002. https://www.nist.gov/speech-testimony/national-electrical-manufacturers-association (accessed February 19, 2017)

Brown, Harold. "FY 1980 Budget, FY 1981 Authorization request and FY 1980-1984 Defense Programs". Report to Congress. January 25, 1979.

Brown, T.J. , et al. "World Mineral Production: 2005-2009." British Geological Survey, Natural Environment Research Council. Nottingham, UK, 2011.

Browning, Larry, and Judy Shetler. *SEMATECH: Saving the Us Semiconductor Industry*. College Station: Texas A&M University Press, 200.

Burkitt, Laurie, Andrew Scobell, and Larry M. Wortzel. *The Lessons of History: The Chinese People's Liberation Army at 75*. Carlisle, PA: Strategic Studies Institute, 2003.

Canada Minister of Natural Resources. Canada Natural Resources. *The State of Global Rare Earths Industry: A Review of Market, Production, Processing and Associated Environmental Issues*, by Sevan Bedrossian, Giovanna Gonzales-Calienes, Christopher Baxter. Canadian Rare Earth Element R&D Initiative. Winnipeg, CA, May 25, 2016.

Carter, Ashton. "Rewiring the Pentagon: Charting a New Path on Innovation and Cybersecurity" Speech, Stanford University, April 23, 2015. U.S. Department of Defense. http://www.defense.gov/News/Speeches/Speech-View/Article/606666/drell-lecture-rewiring-the-pentagon-charting-a-new-path-on-innovation-and-cyber (accessed December 30, 2016).

Chatterjee, Shubham, Shalabh Agarwal, and Asoke Nath. "Scope and Challenges in Light Fidelity (LiFi) Technology in Wireless Data Communication." *International Journal of Innovative Research in Advanced Engineering* 2, no. 6 (June 2015): http://www.academia.edu/14033937/IJIRAE_Scope_and_Challenges_in_Light_Fidelity_LiFi_Technology_in_Wireless_Data_Communication (accessed December 30, 2016).

Cho, Renee. "Rare Earth Metals: Will We Have Enough?" Columbia University - Earth Institute. http://blogs.ei.columbia.edu/2012/09/19/rare-earth-metals-will-we-have-enough/ (accessed September 9, 2016).

Churchill II, Winston S. *Defending the West*. Westport, CT: Arlington House, 1981.

Clinton, Hillary, Senator. “Political Address.” Lecture, Princeton, Valparaiso, Indiana, April 12, 2008. ABCnews, http://abcnews.go.com/Politics/Vote2008/story?id=4757257&page=1 (accessed on October 2, 2016)

Clinton, William. “Message to the Congress Transmitting Proposed Legislation on Permanent Normal Trade Relations with China.” Washington D.C., March 8, 2000. Office of the President of the United States, http://www.presidency.ucsb.edu/ws/index.php?pid=58115&st=China+Trade&st1= (accessed December 29, 2016)

Commission on the Theft of American Intellectual Property. “IP Commission Report.” *The National Bureau of Asian Research*. May 2013

Congressional Research Service. *“The Specialty Metal Clause: Oversight Issues and Options for Congress.”* February 2014 by Valerie Bailey Grasso. Open-file report, CRS Report for Congress. Washington D.C. 2014.

Congressional Research Service. *“Rare Earth Elements: The Global Supply Chain.”* December 2014 by Marc Humphries. Open-file report, CRS Report for Congress. Washington D.C. 2013.

“Consider Improving Refining and Petrochemical Integration as a Revenue-Generating Option.” Hydrocarbon Processing 80, no.11 (November 2001) Academic Search Premier, EBSCOhost (accessed December 31, 2016).

Davies, Andrew. “The Fallacies of the “Third Offset Strategy.”” RealClearDefense. August 4, 2016. http://www.realcleardefense.com/articles/2016/08/04/the_fallacies_of_the_third_offset_strategy_109668.html (accessed October 2, 2016).

Dou, Eva and Wakabayashi, Daisuke. “Apple’s Challenges in China Underlined by Patent Dispute.” *The Wall Street Journal.* June 17, 2016. http://www.wsj.com/articles/beijing-regulator-orders-apple-to-stop-sales-of-two-iphone-models-1466166711 (accessed September 7, 2016)

Els, Frik. “Chinese Rare Earth Giant Born.” *Mining.com.* December 16, 2014, http://www.mining.com/chinese-rare-earth-giant-born-62354/ (accessed February 20, 2017).

Els, Frik. “Largest Known Rare Earth Deposit Discovered in North Korea.” *Mining.com*, December 5, 2013. http://www.mining.com/largest-known-rare-earth-deposit-discovered-in-north-korea-86139/ (accessed October 10, 2016).

Emsley, John. *Nature's Building Blocks: An A-z Guide to the Elements*. Oxford: Oxford University Press, 2011.

Free, Kathryn. “The Future of Rare Earth Recycling.” New York University’s Scienceline: The Shortest Distance between You and Science. http://scienceline.org/2014/03/the-future-of-rare-earth-recycling/ (accessed December 26, 2016).

Freedberg, Jr., Sydney J. “SecDef Carter Predicts His Reforms Will Endure.” *Breaking Defense*. http://breakingdefense.com/2016/07/pentagon-reforms-will-endure-under-next-president-secdef-carter/ (accessed September 4, 2016).

Freidman, Thomas. *The World is Flat: A Brief History of the Twenty-First Century*. New York: Farrar, Straus and Giroux. 2005.

Geological Society of London. *Rare Earth Elements*. London: Geological Society of London, 2011. https://www.geolsoc.org.uk/~/media/shared/documents/policy/Rare%20Earth%20Elements%20briefing%20note%20final%20%20%20new%20format.pdf (accessed December 28, 2016).

Gholz, Eugene. "*Rare Earth Elements and National Security*." New York: Council on Foreign Relations, 2014

Hagel, Chuck. "Defense Innovation Days Opening Keynote." (Speech, Washington D.C., January 28, 2015) Department of Defense. http://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies (accessed September 29, 2016).

Hagel, Chuck. "Reagan National Defense Forum Keynote." (Speech, Simi Valley, CA, November 15, 2014) Department of Defense. http://www.defense.gov/News/Speeches/Speech-View/Article/606635 (accessed September 29, 2016).

Hurst, Cindy. "China's Rare Earth Elements Industry: What Can the Wet Learn?" *Institute for the analysis of Global Security*. March 2010

Hayek, Friedrich. *The Road to Serfdom*. Chicago: University Of Chicago Press, 2007.

Ito, Masami and Aoki, Mizuho. "Senkaku Collisions Video Leak Riles China." *The Japan Times News*. November 6, 2010, http://www.japantimes.co.jp/news/2010/11/06/news/senkaku-collisions-video-leak-riles-china/ (accessed October 2, 2016).

Jamasmie, Cecilia. "Skepticism Grows Over North Korea's Massive Rare Earth Discovery." *Mining.com*, March 27, 2015. http://www.mining.com/scepticism-grows-north-koreas-massive-rare-earth-discovery/ (accessed October 16, 2016).

Karinja, Filip. "Sinosteel MECC Selected by Northern Minerals as EPC Contractor for Browns Range Pilot Plant." http://finfeed.com/juniors/ntu/sinosteel-mecc-selected-northern-minerals-epc-contractor-browns-range-pilot-plant/20161123/ (accessed November 25, 2016).

Kennedy, James. "Address to International Atomic Energy Agency on Thorium and Rare Earth Elements," Speech, Vienna Austria. June 27, 2014

Kennedy, James. "Here's a Way Out of Our Rare-Earths Mess." *Defense One* (May 12, 2016): 1. http://www.defenseone.com/ideas/2016/05/heres-way-out-our-rare-earths-mess/128250/ (accessed December 30, 2016).

King, Hobart. "REE – Rare Earth Elements and Their Uses." *Geology.com*. http://geology.com/articles/rare-earth-elements/ (accessed October 11, 2016).

Kramer, Sarah, and Dave Mosher. "Here's How Much Money It Actually Costs to Launch Stuff Into Space." *Business Insider*, Jul. 20, 2016. http://www.businessinsider.com/spacex-rocket-cargo-price-by-weight-2016-6 (accessed December 30, 2016).

Lnoue, Yuko. "China Lifts Rare Earth Export Ban to Japan: Trader," *Reuters World News.* September 29, 2010, http://www.reuters.com/article/us-japan-china-export-idUSTRE68S0BT20100929 (accessed October 2, 2016).

Lucius, Casey J. "China's Critical Resources Strategy." Chau, Donovan C. and Kane, Thomas M. (Eds.). *China and International Security: History, Strategy, and 21st-Century Policy.* (Santa Barbara: Praeger Security International, 2014), Vol. 3.

Mancheri, Nabeel, Lalitha Sundaresan, and S. Chandrashekar. *Dominating the World: China and the Rare Earth Industry*. Bangalore: National Institute of Advanced Studies, 2013. http://investorintel.com/wp-content/uploads/2014/01/China-rare-earth-strategyin-wHighlights-.pdf (accessed November 29, 2016)

Mao Zedong, "Speech at the Supreme state Conference," September 8, 1958. *Quotations from Chairman Mao Tsetung* (Peking: Foreign Languages Press, 1967).

Marshall, Jessica. "Why Rare Earth Recycling Is Rare (And What We Can Do About It)." University of Minnesota's ensia. https://ensia.com/features/why-rare-earth-recycling-is-rare-and-what-we-can-do-about-it/ (accessed December 29, 2016).

McLaughlin, Patrick, George Breit, Edward du Bray, Alan Koenig, and Poul Poul. "Rare Earth Elements in Sedimentary Phosphate Deposits: Solution to the Global Ree Crisis?" *ScienceDirect: International Association for Gondwana Research* 27, no. 2 (February 2015): 1. http://www.sciencedirect.com/science/article/pii/S1342937X14003128 (accessed February 20, 2017).

Mehta, Aaron. "Defense Department Budget: $18B over FYDP for Third Offset." *DefenseNew*. February 9, 2016. http://www.defensenews.com/story/defense/policy-budget/budget/2016/02/09/third-offset-fy17-budget-pentagon-budget/80072048/ (accessed September 1, 2016)

Mims, Christopher. "China Seeks Out Unlikely Ally: U.S. Tech Firms." *The Wall Street Journal*. September 21, 2015. http://www.wsj.com/articles/china-seeks-out-unlikely-ally-u-s-tech-firms-1442808042 (accessed September 7, 2016)

Moores, Simon. **"**Ban on Rare Earths Exports in Reaction to Vessel Capture, Japan Traders Confirm." *Industrial Minerals Magazine*. September 22, 2010. http://www.indmin.com/Article/2675767/Energy-LatestNews/China-bans-Japan-RE-exports.html (accessed on October 10, 2016)

Nixon, Richard. *The Real War*. New York: Warner Books, 1980.

OECD (2015). *Environment at a Glance 2015: OECD Indicators*. Paris: OECD Publishing, 2015. http://dx.doi.org/10.1787/9789264235199-en (accessed December 29, 2016).

Ogawa, Yukiko, Daisuke Ando, Yuji Sutou, and Junichi Koike. "A Lightweight Shape-Memory Magnesium Alloy." Tohoku University. http://www.tohoku.ac.jp/en/press/new_lightweight_shape_shifting_alloy.html (accessed December 30, 2016).

Perry, William J. "Desert Storm and Deterrence." Foreign Affairs, Vol 70, Issue 4 (Fall 1991) https://www.jstor.org/stable/20044194 (accessed October 1, 2016).

Simmons, Lee. "Rare-Earth Market." *ForeignPolicy*, July 12, 2016. https://foreignpolicy.com/2016/07/12/decoder-rare-earth-market-tech-defense-clean-energy-china-trade/ (accessed August 30, 2016).

Topf, Andrew. "First Heavy Rare Earths Mine in Australia Gets Pilot Plant Approved." Mining.com, September 18, 2016. http://www.mining.com/first-heavy-rare-earths-mine-australia-gets-pilot-plant-approved/ (accessed on October 1, 2016)

Tu, JianJun "An Economic Assessment of China's Rare Earth Policy," *The Jamestown Foundation's* China Brief Vol X, Issue 22 (November 2010):

U.S. Congress. House. Committee on Foreign Affairs Subcommittee on Asia and the Pacific. *China's Monopoly on Rare Earths: Implications for U.S. Foreign and Security Policy*. 112th Cong., 1st sess., September 21, 2011. Serial 112-63.

U.S. Congress. House. Committee on Air and Land Force Subcommittee. *Air Force and Army Airlift*. 110th Cong., 1st sess., March 7, 2007. H. Hrg. 110-28.

U.S. Congressional Research Service. *"Rare Earth Elements: The Global Supply Chain."* December 2014 by Marc Humphries. Open-file report, CRS Report for Congress. Washington D.C. 2013.

U.S. Department of Defense. *Annual Report for Fiscal Year 1982*, by Harold Brown. Report of Security of Defense to Congress. Washington, DC, 1981.

U.S. Department of the Interior. United States Geological Survey. *China's Rare-Earth Industry*, by Pui-Kwan Tse. Open-file report, U.S. Geological Survey. Reston, Virginia, 2011

U.S. Department of the Interior. United States Geological Survey. *Mineral Commodity Summaries 2016.* Rare Earth Chapter by Joseph Gambogi. Open-file report, U.S. Geological Survey, Reston, Virginia, 2016.

U.S. Department of the Interior. United States Geological Survey. *The Mineral Industry of Australia*, by Pui-Kwan Tse. Open-file report, U.S. Geological Survey. Reston, Virginia, 2009.

U.S. Department of the Interior. United States Geological Survey. *Rare Earth Elements-Critical Resources for High Technology*, by Gordon B. Hazel, James B. Hedrick, and Greta J. Orris. Open-file report, U.S. Geological Survey, pt. 087-02. Washington, DC, 2002.

U.S. Department of the Interior. United States Geological Survey. *Rare Earth Elements—End Use and Recyclability*. Goonan, Thomas G. open-file, U.S. Geological Survey. Reston, Virginia, 2011.

U.S. Environmental Protection Agency. *Multi-Agency Radiation Survey and Site Investigation Manual*. EPA 402-R-97-016, Rev. 1. Washington, DC, 2000.

U.S. Government Accountability Office. *Rare Earth Materials: Developing a Comprehensive Approach Could Help DOD Better Manage National Security Risks in the Supply Chain*. Report to Congressional Committees, pt. GAO-16-161. Washington, DC, 2016.

U.S. House Committee on Air and Land Forces Subcommittee. *Air Force and Army Airlift*. 110th Cong., 1st sess., 2007. H. Hrg. 110-28.

U.S. House Committee on Foreign Affairs Subcommittee on Asia and the Pacific. *China's Monopoly on Rare Earths: Implications For U.S. Foreign And Security Policy*. 112th Cong., 1st sess., 2011. Serial 112-63.

U.S. Securities and Exchange Commission. *W. R. Grace and CO. Form 10-K*. Form 10-K. Washington, DC, 2015. https://www.sec.gov/Archives/edgar/data/1045309/000104530915000030/gra-201410xk.htm (accessed January 1, 2017)

Vanhaeren, Monique. "EREAN Report Summary." European Union's Community Research and Development Information Service. http://cordis.europa.eu/result/rcn/181390_en.html (accessed December 29, 2016).

Verrax, Fanny. "Recycling Toward Rare Earth Security." *The Political Economy of Rare Earth Elements: Rising Powers and Technological* Change. New York: Palgrave Macmillan, 2015.

Whittle, Richard. "Pentagon Fails to Act on Crucial Rare Earth Minerals." *Breaking Defense*. March 01, 2016. http://breakingdefense.com/2016/03/pentagon-fails-to-act-on-crucial-rare-earth-minerals/ (accessed on August 28, 2016)

Work, Bob. “The Third U.S. Offset Strategy and it Implications for Partners and Allies.” Speech, Washington D.C, January 28, 2015. U.S. Department of Defense, http://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies (accessed September 6, 2016).

World Trade Organization. *DS431: China — Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum*. Prepared by World Trade Organization. Dispute Settlement. Geneva, Switzerland, 2015.

World Health Organization, *Ten Chemicals of Major Public Health Concern*. Geneva: World Health Organization, 2010. http://www.who.int/ipcs/assessment/public_health/chemicals_phc/en/ (accessed December 29, 2016).

Worstall, Tim. “Us Sues China at WTO Over Minerals Export Taxes Again - and Is Likely to Win.” Forbes. http://www.forbes.com/sites/timworstall/2016/07/14/us-sues-china-at-wto-over-minerals-export-taxes-again-and-is-likely-to-win/#699536985831 (accessed November 29, 2016).

Wubbeke, Jost. “China’s Rare Earth Industry and End-Use: Supply Security and Innovation.” *The Political Economy of Rare Earth Elements: Rising Powers and Technological* Change. New York: Palgrave Macmillan, 2015.

Yoders, Jeff. “Rare Earths MMI: Japanese Investors Save Lynas Corp.” MetalMiner. http://agmetalminer.com/2016/11/08/rare-earths-mmi-japanese-investors-save-lynas-corp/ (accessed November 28, 2016).

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